Mass Profiles and Shapes of Cosmological Structures
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DOWNSIZING SCALING RELATIONS

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Abstract. Faber–Jackson and Tully–Fisher scaling relations for elliptical and spiral galaxy samples up to $z = 1$ provide evidence for a differential behaviour of galaxy evolution with mass. In compliance with the downsizing scenario, the stellar populations of less massive galaxies display a stronger evolution than the more massive ones. For spirals, this may be attributed to a suppressed star formation efficiency in small dark matter halos. For ellipticals, star formation must have been negligible at least during the past $\sim 4\,$Gyr in all environments.

1 Introduction

Cold Dark Matter dominated structure formation predicts that small systems form first which then merge and build up larger galaxies. If star formation peaks at the epoch of galaxy assembly then the stellar populations of dwarf galaxies should be on average older than of giant galaxies. However, the majority of local galaxies in the SDSS show for example a trend of increasing age with mass (Kauffmann et al. 2003). Also, distant spiral galaxies in DEEP exhibit an evolving slope in the metallicity–luminosity relation in the sense that smaller galaxies are brighter than the larger ones in the past for their metallicities (Kobulnicky et al. 2003). This phenomenon of a mass-dependent evolution of the stellar population is often called the "anti-hierarchical behaviour" of the baryons or "downsizing" since it runs opposite to the mass assembly history of galaxies.

2 Evolution of Spiral Galaxies

We derive from VLT/FORS spectra 78 and 52 spatially resolved rotation curves of spiral galaxies with $0.2 \leq z \leq 1$ drawn from the FORS and William Herschel Deep Fields and combine them with HST/ACS imaging for a Tully–Fisher analysis (Böhm et al. 2004). Fitting all distant galaxies with high quality RCs only (63), a significantly ($> 3\,\sigma$) flatter slope is found than for the local sample. Whereas

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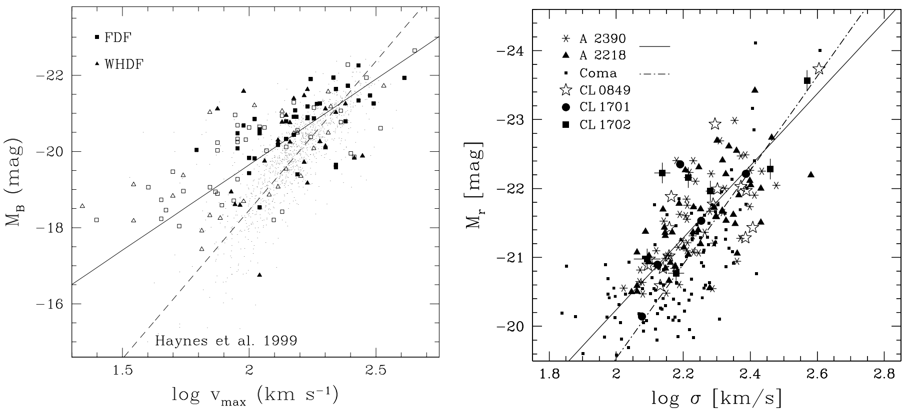

Fig. 1. Left: TFR in B of field spirals, Right: FJR in r_{Gunn} of cluster ellipticals.

galaxies with small maximum rotation velocities $v_{\max}$ are much brighter than their local counterparts, the rapid rotators show only very little evolution. If $v_{\max}$ is taken as a measurement of total mass, this change of slope indicates a mass-dependent evolution of spiral galaxies. Fitting optical/NIR colors individually with a chemical enrichment code, bigger galaxies have on average higher star formation efficiencies and older mean stellar ages than smaller ones (Ferreras et al. 2004).

3 Evolution of Elliptical Galaxies

We investigate 96 E and S0 galaxies in the rich clusters Abell 2218 & Abell 2390 (Fritz et al. 2005) and 27 early-type galaxies in three poor clusters that have 1-2 dex lower x-ray luminosities to search for environmental dependences at $z \approx 0.2$. Both samples display a similar average mild brightening in Gunn r of $\sim 0.3-0.4^m$ which is compatible with a pure passive evolution of an old stellar population. Dividing our sample of rich cluster galaxies into halves ($N = 48$ each) at a velocity dispersion of $\sigma = 170\,\mathrm{km/s}$, we detect a significant difference with less massive ellipticals having a larger offset (0.6^m) than more massive ones (0.0^m) from the local Faber–Jackson relation of Coma galaxies (Jørgensen et al. 1995).

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